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UVES Abundances of Stars in Nearby Galaxies: How Good are Theoretical Isochrones?

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Abstract. Here we report some results from an ESO-VLT programme to observe individual stars in nearby dwarf galaxies at high resolution with the UVES spectrograph (Tolstoy, Venn, Shetrone, Primas, Hill, Kaufer & Szeifert 2002, submitted to AJ). We mainly concentrate on illustrating the issues and uncertainties surrounding our efforts to determine the ages of stars for which we have accurately measured [Fe/H] and [α/Fe].

1. Determining Ages from Isochrones

In principle it ought to be a straight forward task to plot the theoretical isochrones at all ages (2−15 Gyr) for a star with an accurately determined metallicity, and find the best fitting age. We have found that isochrones of different groups do not always produce the same results, and on occasion none of the isochrones of any group go through the position of the star in a Colour-Magnitude Diagram. This is not found to be such a major problem for globular clusters. To highlight the issues we plot in Figure 1 the results for three stars in one of the four dwarf spheroidal galaxies in our sample - Fornax, along with the Yale-Yonsei (α=0) isochrones of Yi *et al.* (2001, ApJS, 136, 417) at 2 Gyr & 15 Gyr. In one case the isochrones are too red, one too blue, and one has no apparent problem.

Even though we reveal some worrying problems, in general we are confident that we can attach ages to the stars we observe which may lack some accuracy in absolute value, but they are appear to be accurate relative to each other. We find that stars which are more metal poor are older than the more metal rich stars. This combination of metallicity and Colour-Magnitude Diagram analysis is the only way to be able to disentangle the star formation history and the corresponding chemical evolution in nearby galaxies.

This work highlights the difficulties in using theoretical stellar evolution tracks verified to work for globular clusters to interpret ages of stars in galaxies. This is not a particular problem of the Yi et al. isochrones. This might be due to fundamental differences in the formation and/or evolution of stars between a globular cluster environment and that of field stars in a galaxy. It is well known that stars in globular cluster stars contain different abundance patterns from all field stars. We need a lot more high resolution spectra of stars in nearby galaxies to better quantify the problem, because there is cuurently no straight forward solution.

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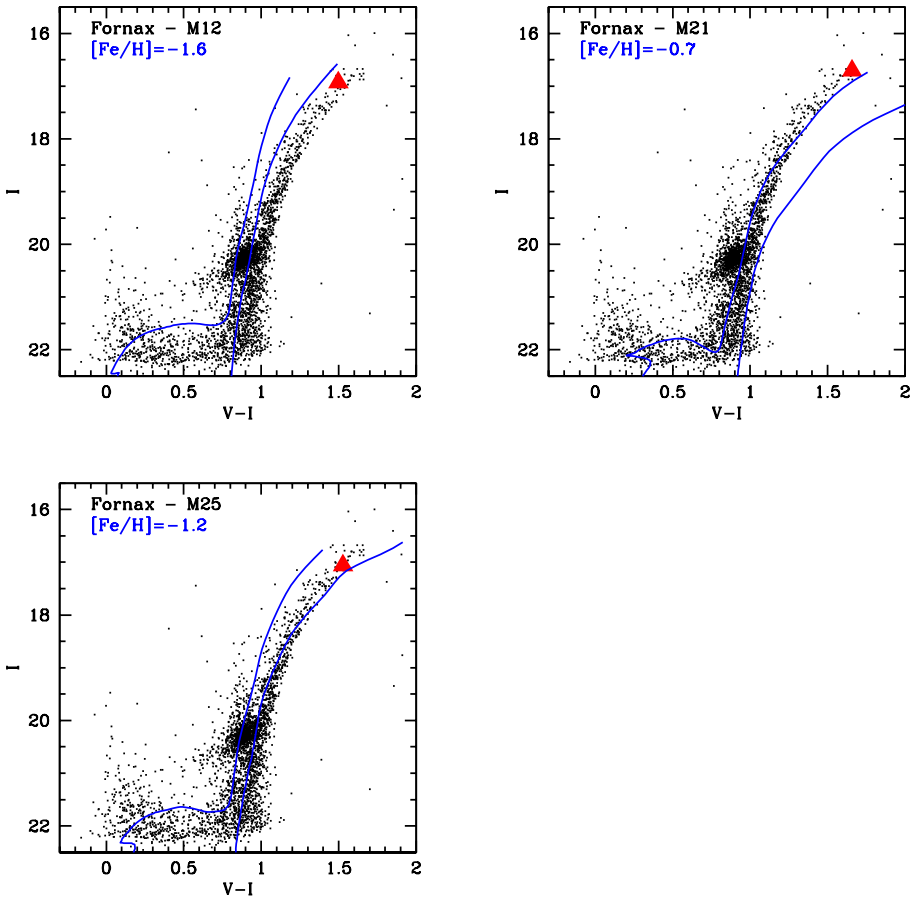

Figure 1. Here we show the results of comparing UVES abundances measured for stars in the Fornax Dwarf Spheroidal Galaxy. In top left hand corner of each plot is listed the name of the star and the UVES measured [Fe/H] for the star symbol plotted on the Colour-Magnitude Diagram. The Yale-Yonsei isochrones ($\alpha = 0$) of Yi *et al.* (2001) at 2 Gyr & 15 Gyr old are also plotted.